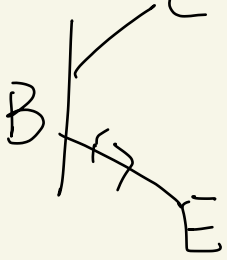
一、二极管：

$U_i=0 \Rightarrow I_D$　$r_D=\frac{U_T}{I_D}$ → 26mV.　$I_d=\frac{U_i}{r_D}$

二、三极管



P→N.

$\dot{A}_u=\frac{\dot{U}_o}{\dot{U}_I}$　$\dot{A}_{us}=\frac{\dot{U}_o}{\dot{U}_s}=\frac{R_i}{R_s+R_i}\dot{A}_u$

$I_B \Rightarrow I_C \Rightarrow U_{CEQ}$　$r_{be}=r_{bb'}+\frac{(1+\beta)U_T}{I_E}$

$U_{om}=\frac{1}{\sqrt{2}}\min\{U_{CEQ}-U_{CES}, I_{CQ}(R_c/\!/R_L)\}$

NPN：

	发射	集
放大：	正	反
饱和	正	正
截止	反	反

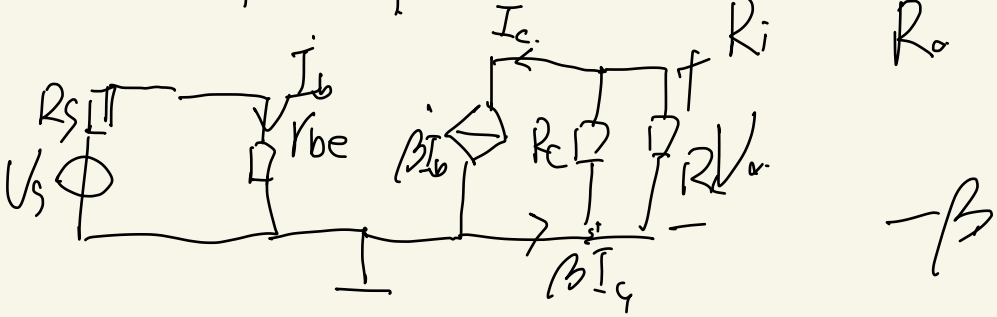
正：$U_B>U_?$

反：$U_B<\cdots$

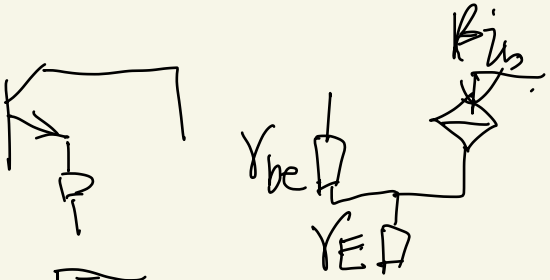
共射

U_i U_o

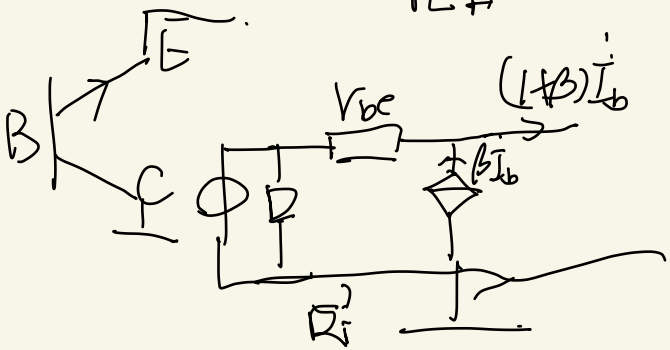
R_i R_o



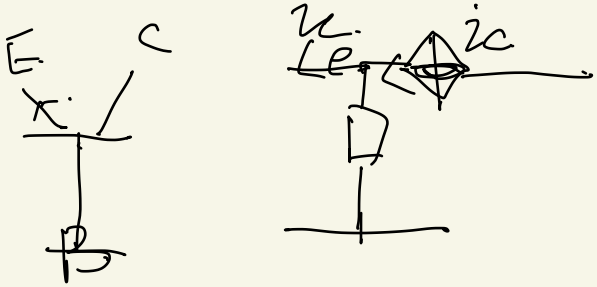
$-\beta$



共集



共基



低通 $\varphi=0$

f_H $\varphi=-\frac{\pi}{4}$

$>f_H$ $-\frac{\pi}{2}$

高 $\varphi=\frac{\pi}{2}$

f_L 45°

$\geq 10f_L$ 0

全 $\varphi=-\frac{\pi}{2}$

$<0.1f_L$ 0

f_{L2} $-\frac{\pi}{2}$

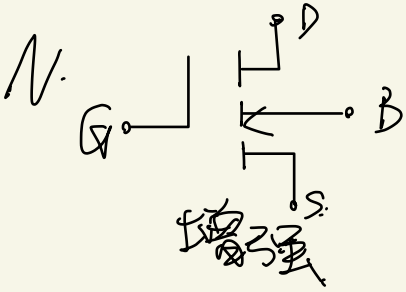
$10f_{L1}$ $-\pi$

$10f_{L1}$ αf_H $-\pi$

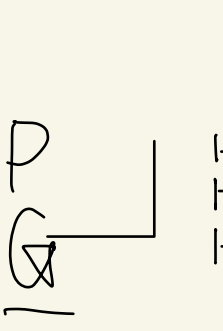
$10f_H$ $-\frac{3\pi}{2}$

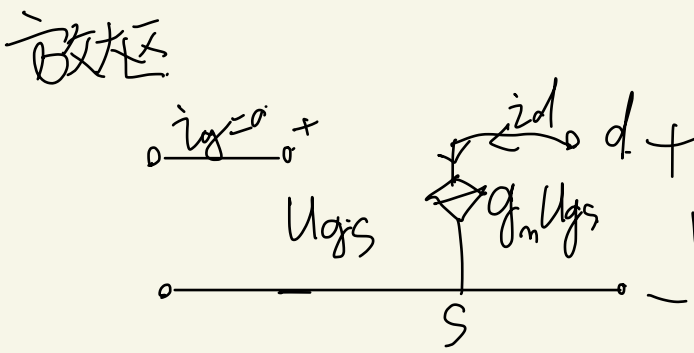
$$\dot{A}_u=\frac{\dot{A}_{um}\,\dot{V}\frac{f}{f_L}}{(1+j\frac{f}{f_L})(1+j\frac{f}{f_{H1}})}=\frac{\dot{A}_{um}}{(1+\frac{f_L}{jf})(1+j\frac{f}{f_H})}$$

$20\lg|\dot{A}_{um}|=$ (⟹)



U_{GS}	U_{GD}	
$>U_{GS(th)}$ 开	$<U_{GS(th)}$ 夹	恒流
>	>	可变电阻
<	×	截断
<	>	恒
<	<	呀
>	×	夹断

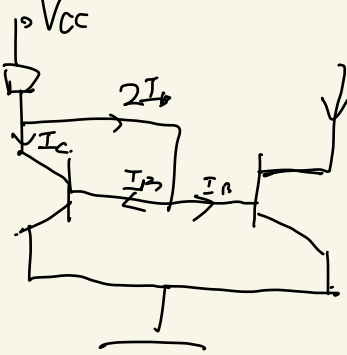




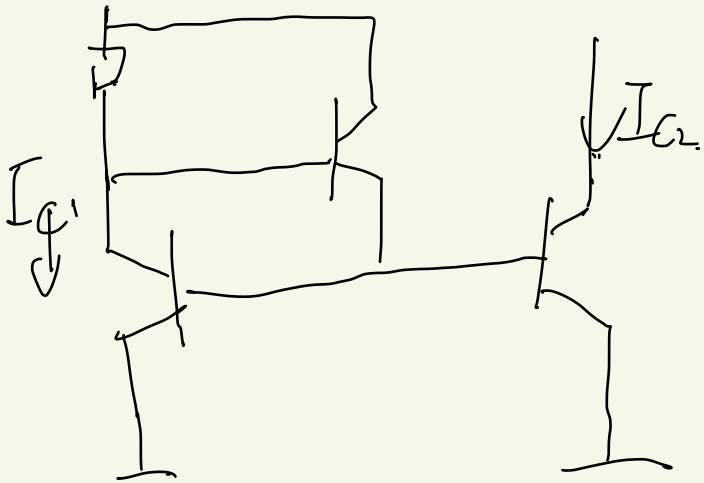
耗尽 $i_D=I_{DSS}\left(1-\frac{U_{GS}}{U_{GS(off)}}\right)^2$ $g_m=\frac{-2}{U_{GS(off)}}\sqrt{I_{DSS}I_D}$

增强 $i_D=I_{DO}\left(\frac{U_{GS}}{U_{GS(th)}}-1\right)^2$ $g_m=\frac{2}{U_{GS(th)}}\sqrt{I_{DO}I_D}$

四：电流源



$$I_o = I_C = \frac{1}{1+\frac{2}{\beta}} I_R$$

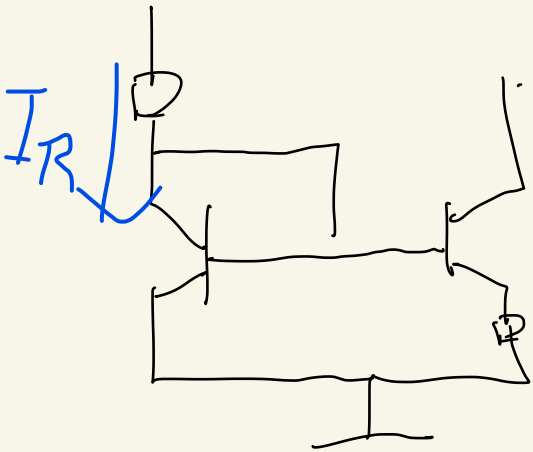


$$I_{C1} = I_{C2} = I_R - I_B$$

$$= I_R - \frac{2I_{C1}}{\beta(1+\beta)}$$

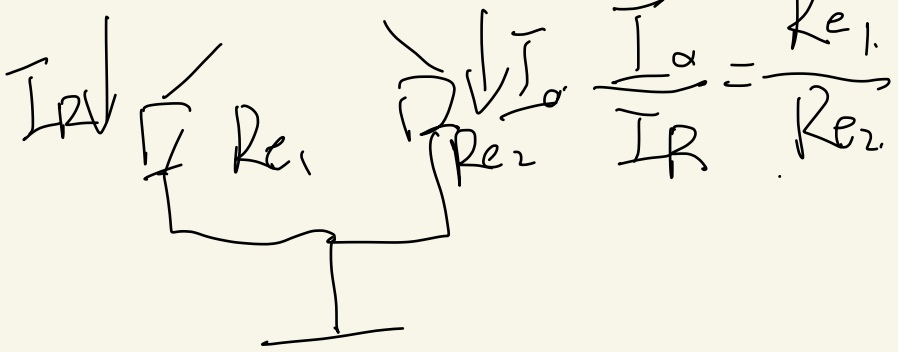
$$\Rightarrow I_o = I_{C1} = I_{C2}$$

$$= \frac{1}{1+\frac{2}{\beta(1+\beta)}} I_R$$



$$I_o = \frac{V_T}{R_e}\left(\frac{I_R}{I_o}\right)$$

$$I_R = \frac{V_{CC} - U_{BE}}{R}$$



$$\frac{I_o}{I_R} = \frac{R_{e1}}{R_{e2}}$$

双出 $A_{ud} = \dfrac{-\beta (R_c // \frac{R_L}{2})}{R_b + r_{be}}$ $A_{uc} = 0$

单出 $A_{ud} = \pm \dfrac{\beta (R_c // R_L)}{2(R_b + r_{be})}$ $A_{uc} = -\dfrac{R_L'}{2R_e}$

$R_{id} = 2(R_b + r_{be})$

$K_{cm} = \left| \dfrac{A_{ud}}{A_{uc}} \right| = \dfrac{\beta R_e}{R_b + r_{be}}$

$\Rightarrow R_c$

$P = \frac{V_{om}^2}{2R_L}$ $P_V = \frac{2}{\pi}\frac{V_{CC}V_{om}}{R_L}$ $V_{om} = V_{CC} - V_{CES}$

$\eta = \frac{\pi}{4}\cdot\frac{V_{om}}{V_{CC}}$ $P_{T_1} = P_{T_2} = P_{om} = 0.2P_{om}$

$\dot{A}_u = \dot{A}_{u1}\cdot\dot{A}_{u2}\cdot\dot{A}_{u3}\cdots$

集运

$K_{CMR} = 20\lg\left|\frac{A_{od}}{A_{uc}}\right|$

五. 压/流 取消Uo 有 流 无 压

串/并 同并 反串

负

二极管 Rf. 右 {U0 压 / 并U0 流} 左 {Ui 并 / 我串}

$F=\frac{X_f}{X_o}$ 电压: $X_o=U$ 电流 $X_o=I$.

串联 $X_f=U_f$ 并联 $X_f=I_f$

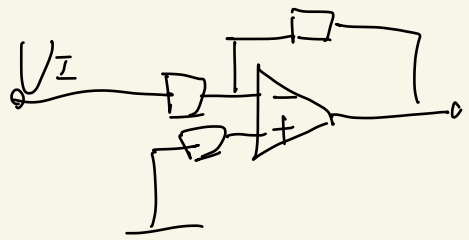
深度 $A_f=\frac{1}{F}$ $A_{uf}=\frac{U_o}{U_i}$

入: 串 $U=U_R$ R个 并 $I=I_R$ R小.

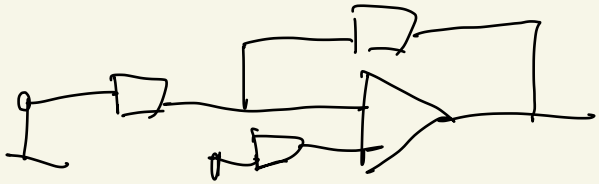
出: 电流 R个 电压 R小

带负载 电压 恒压源 恒流

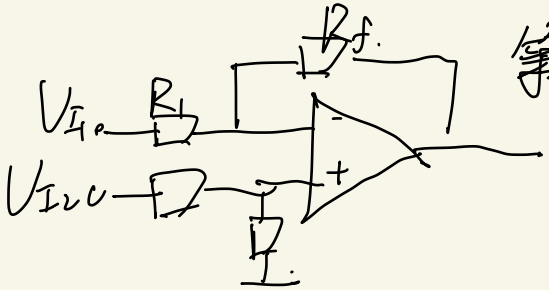
六：



$$U_o = -\frac{R_f}{R_1} U_I$$

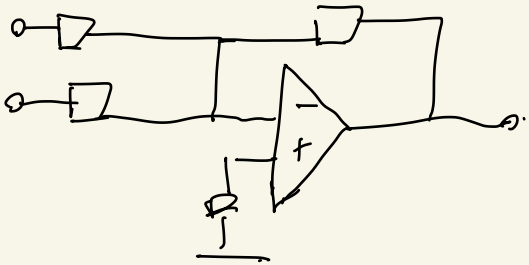


$$U_o = \left(1 + \frac{R_2}{R_1}\right) U_I$$

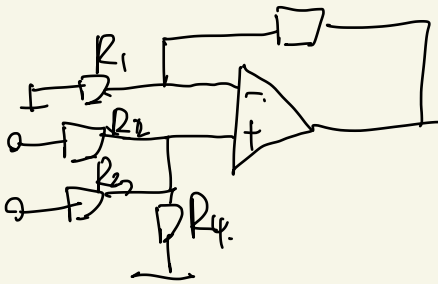


等

$$U_o = \frac{R_f}{R_1}(U_{I_2} - U_{I_1})$$

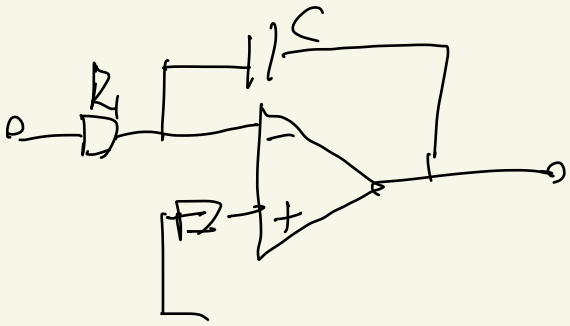


$$U_o = -R_f\left(\frac{U_{I_1}}{R_1} + \frac{U_{I_2}}{R_2}\right)$$



$$U_o = \left(1 + \frac{R_f}{R_1}\right) U_+$$

$$= \left(1 + \frac{R_f}{R_1}\right)\left(\frac{R_3 /\!/ R_4}{R_2 + R_3 /\!/ R_4} U_{I1} + \frac{R_2 /\!/ R_4}{R_3 + R_2 /\!/ R_4} U_{I2}\right)$$

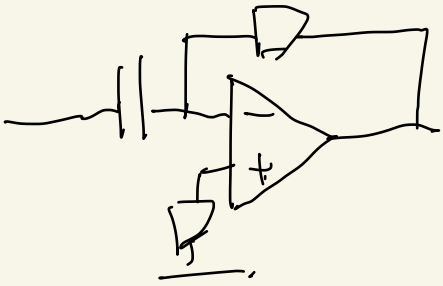


$$U_o = -\frac{1}{R_1 C}\int U_I dt + U_C(0)$$

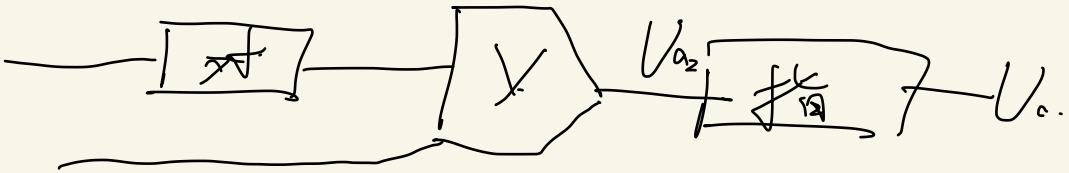
$$= -\frac{U_I}{R_1 C}t.$$

方波. $T = RC$

$$U_{o(m)} = U_0\left(\frac{T}{4}\right)$$



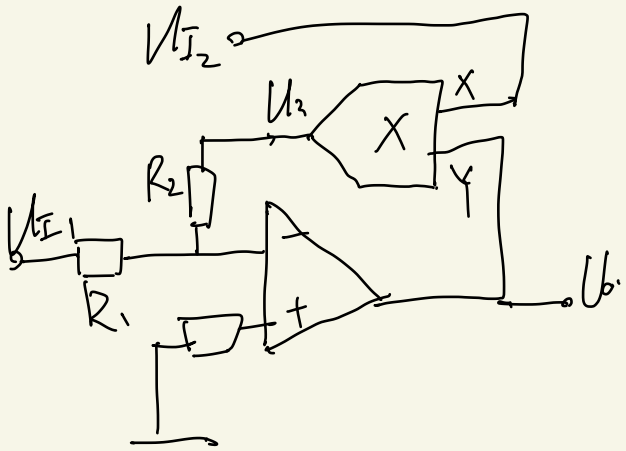
$$U_o = -R_f C_1 \frac{dU_I}{dt}.$$



N

$$U_{o2} = K_3 e^{U_{o2}} = K_3 e^{K_2 N U_{o1}} = K_3 e^{K_2 N K_1 \ln U_I}$$

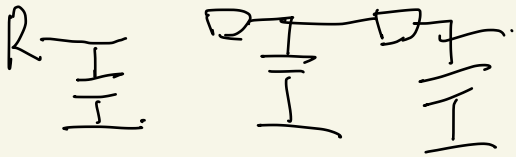
$$= K_3 U_I^{N}$$



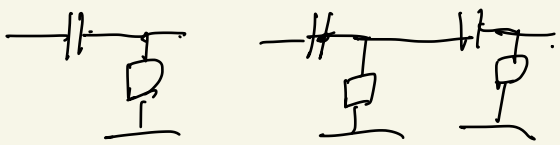
$$U_3 = -\frac{R_2}{R_1}U_1 = KU_0U_2$$

$$U_o = -\frac{R_2}{KR_1}\frac{U_1}{U_2}$$

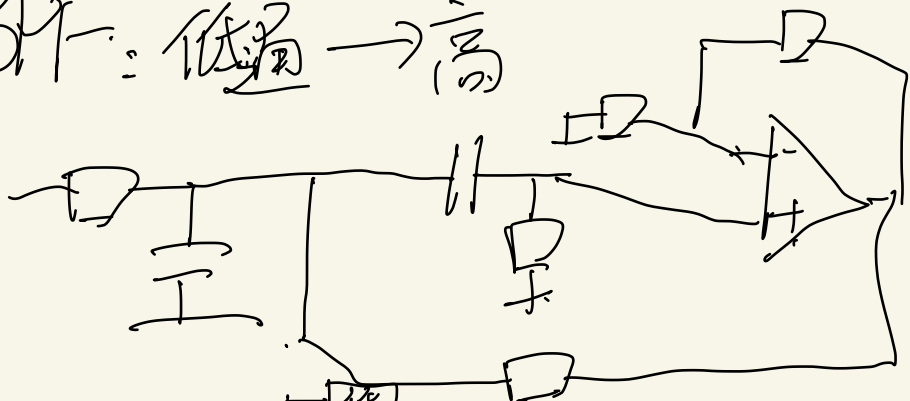
LPF: 2LPF



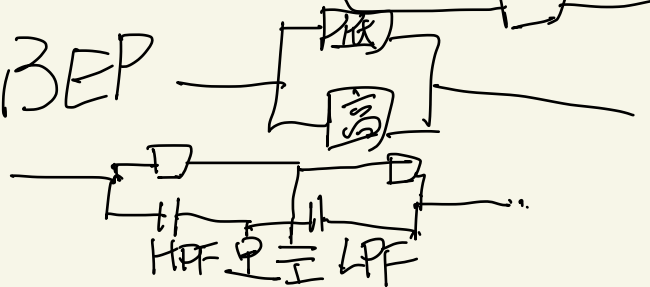
HPF 2HPF



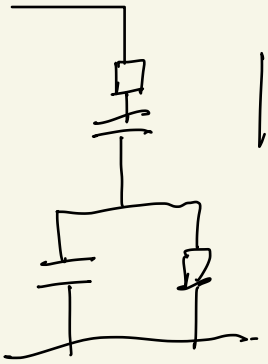
BPF: 低通 → 高



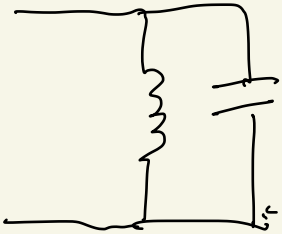
BEP



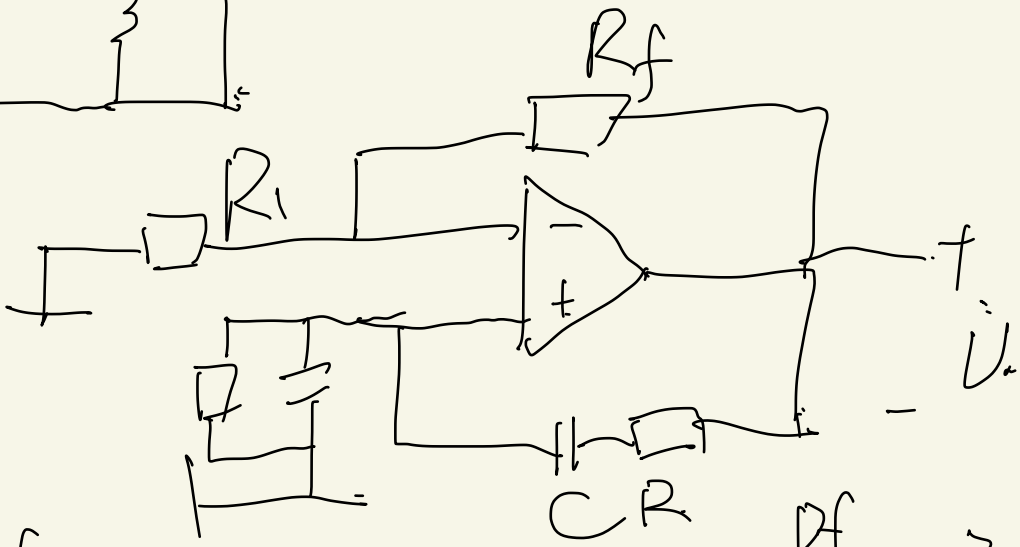
七. 起振: 正反馈 $\Rightarrow \begin{cases} |\dot{A}\dot{F}| \geq 1 \\ \varphi_{AF} = \varphi_A + \varphi_F = 2n\pi \end{cases}$



$|\dot{F}_u| = \frac{1}{3} \quad \omega = \frac{1}{RC}$



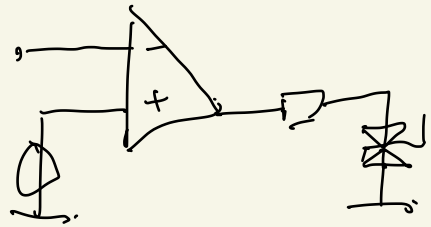
$f = \frac{1}{2\pi\sqrt{LC}}$



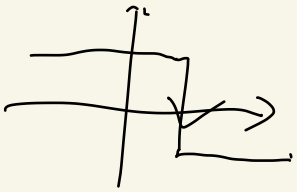
$f_0 = \frac{1}{2\pi RC} \quad |\dot{A}_u| = 1 + \frac{R_f}{R_1} > 3$

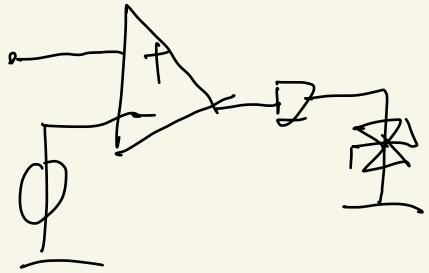
$\Rightarrow R_f > 2R_1$

单限.

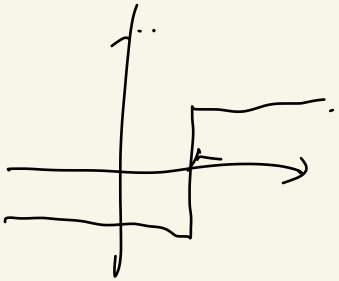


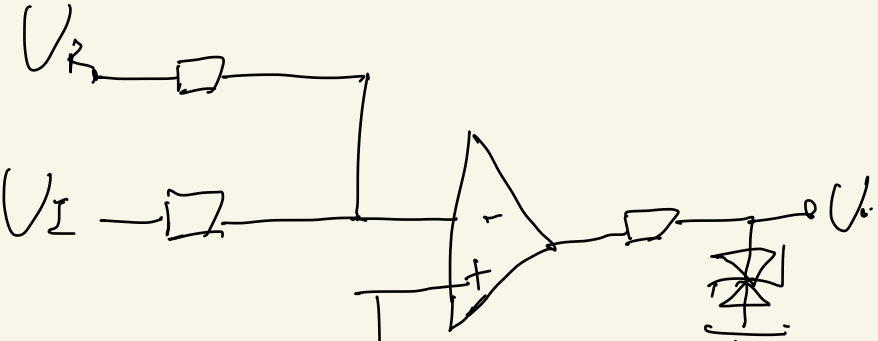
$U_T = U_{REF}$



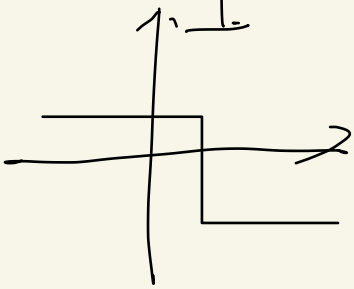


$U_T = U_{REF}$



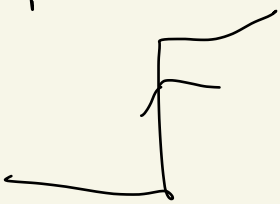


$U_T = -\frac{R_2}{R_1} U_R$

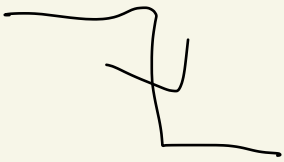


$U_T = U_R$

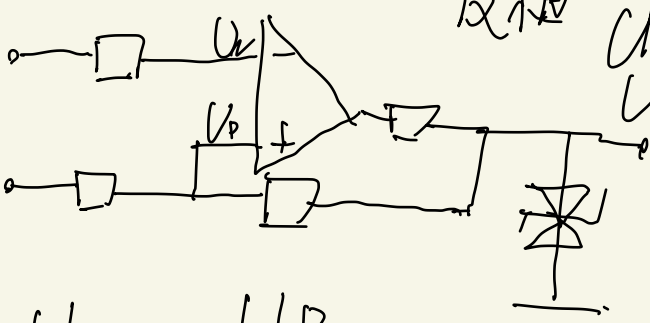
同相



反



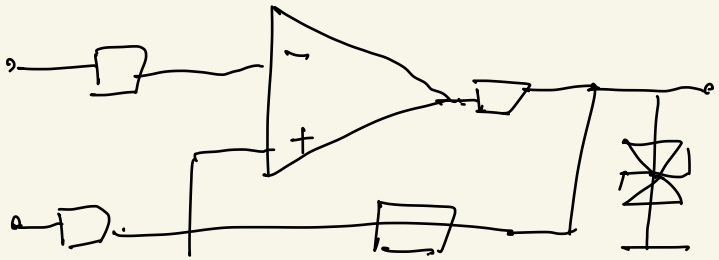
滞回



$$U_P=\frac{R_1}{R_1+R_2}U_{REF}+\frac{U_o R_2}{R_1+R_2}$$

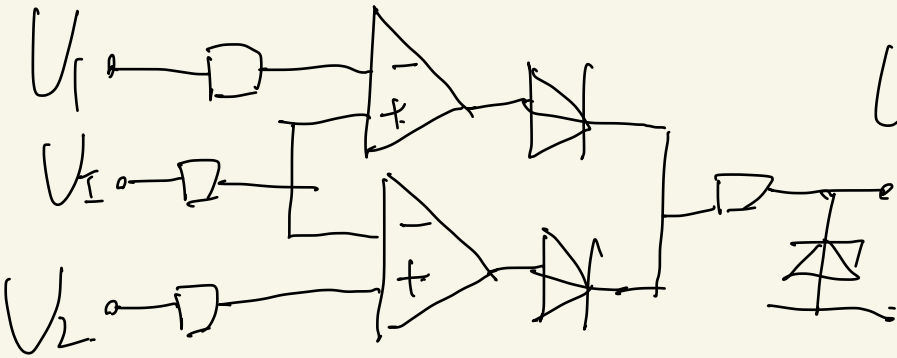
$$U_N=U_I$$

$$\Rightarrow U_T=\frac{U_{REF}R_1+U_o R_2}{R_1+R_2}$$



$U_o=\pm U_Z$

$U_T=\mp U_T$



$U_2^+ < U_1^-$

U_o

$U<U_2, U>U_1$

$U_o=U_Z$

$U_2 < U < U_1$

半波 $U_o = 0.45U_2$ $I_{O(AV)} = I_o$ $U_{RM} = \sqrt{2}U_2$

全波 $U_o = 0.9U_2$ $I_{O(AV)} = I_o/2$ $U_{RM} = 2\sqrt{2}$

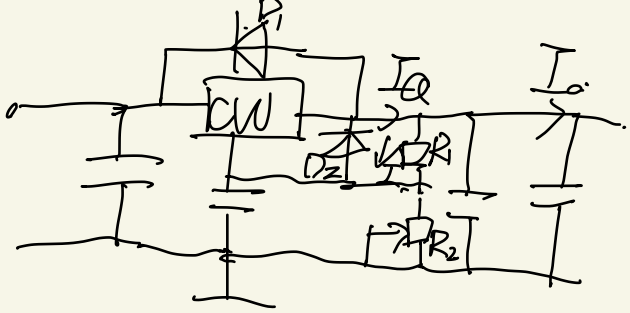
桥 $U_o = 0.9U_2$ $I_{O(AV)} = I_o/2$ $U_{RM} = \sqrt{2}U_2$

电容 $U_o = 1.2U_2$

$$U_{max} = \frac{R_1 + R_2 + R_3}{R_1} U_Z \qquad U_{min} = \frac{R_1 + R_2 + R_3}{R + R_1} U_Z$$

三极管稳压 $U_o = \frac{R_1 + R_2}{R_2} U_Z$

三端可调



$$U_o = 1.25\left(1 + \frac{R_2}{R_1}\right) U_Z$$